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(54) Froth flotation

(57) The invention concerns a process for the flotation of a mineral, which comprises effecting flotation of the mineral using at least one oil derived from a plant source. The oil may be sunflower, maize, soya bean or cotton seed oil. The mineral conveniently is coal.

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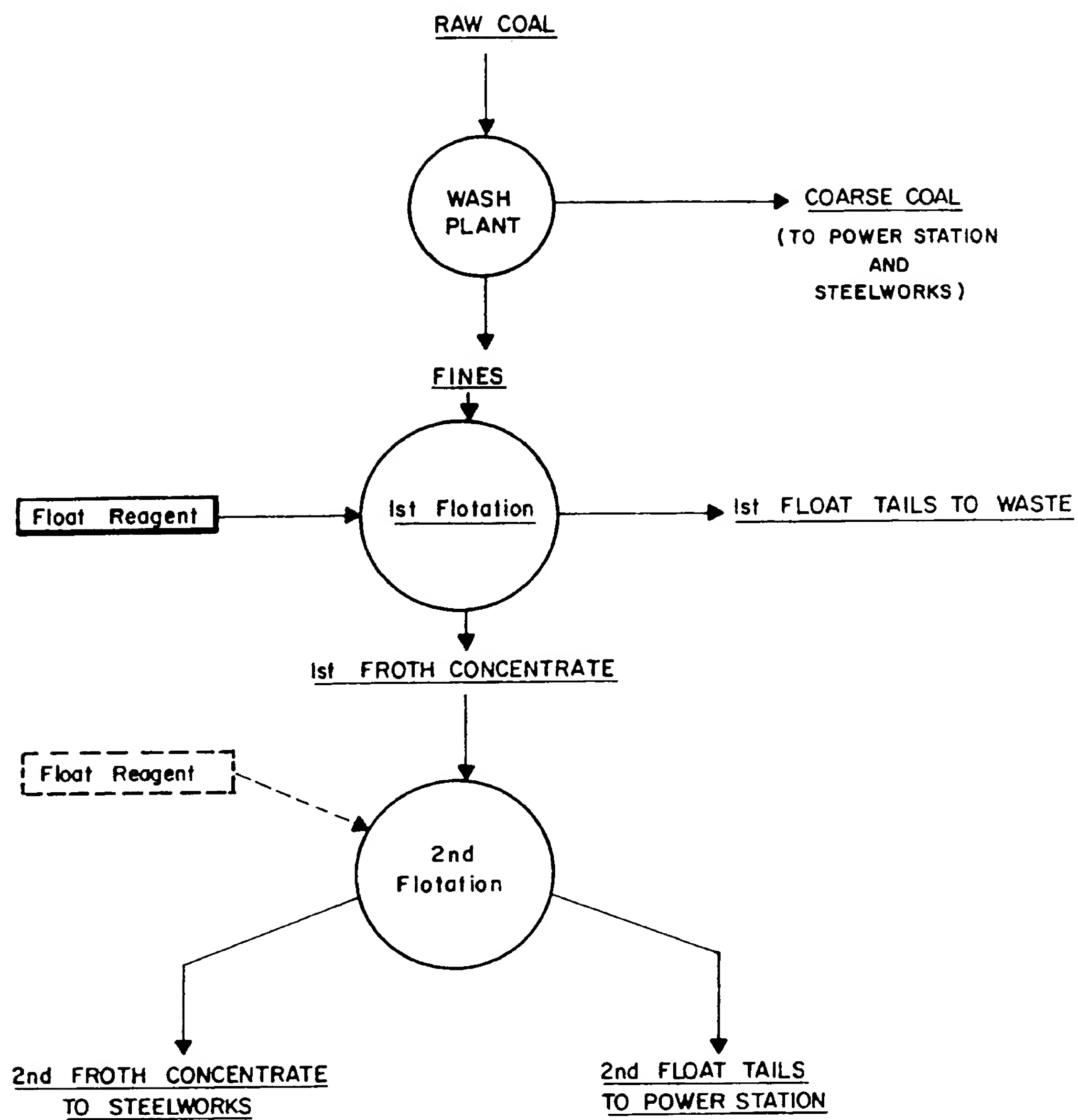
RAW COAL
WASH PLANT
COARSE COAL
(TO POWER STATION
AND
STEELWORKS)
FINES
Float Reagent
Ist Flotation
Ist FLOAT TAILS TO WASTE
Ist FROTH CONCENTRATE
Float Reagent
2nd Flotation
2nd FROTH CONCENTRATE
TO STEELWORKS
2nd FLOAT TAILS
TO POWER STATION

FIG. I

SPECIFIC.·TION

Froth flotation

This invention relates to a froth flotation.

The Applicants are aware that the process of froth flotation has been used for separating coal from gangue material such as shale and pyrite. Generally, this involves first crushing the coal, thereafter screening it and subsequently passing the screened fine coal to a flotation tank after treating the coal with a frothing agent and generally a collector. Examples of frothing agents which have been used, are alcohols. We are aware that kerosene and fuel oil are being used as collectors.

The present invention concerns the use, in the flotation of minerals, of an oil derived from plants. More particularly, the present invention provides a process for the flotation of minerals, which comprises effecting flotation of the mineral using at least one oil derived from plants.

A particular example of an oil which is derived from plants and which can be used, is sunflower seed oil, known from the genus Helianthusonnuus. Other oils are, for example, maize, soya bean and cotton seed oils.

The mineral to be subjected to froth flotation conveniently may be crushed coal. For example, the mineral such as coal may be crushed and made into a water slurry (eg with a concentration of 5 to 20% by weight) and the plant oil and also a frothing agent are added. Thereafter, air may be blown through the slurry while agitating it. The hydrophobic particles of coal attach themselves to the air bubbles formed in the slurry which carry them to the surface where they are skimmed off. The shale (which is high in inorganic mineral content, i.e. ash) is substantially unaffected by the chemical reagents and, being heavier, sinks to the bottom of the slurry and is removed. Generally, a coal concentrate can be obtained which has an ash content as low as 5–10% by weight.

The plant oil has the advantage that it can be grown locally and so will not be subject to restrictions which arise from time to time on mineral oils such as kerosene and fuel oil.

The process can be carried out on coal to separate it into two floats, one of which is suitable for supplying to a steel works and has a low ash content of about 10%, and one of which is suitable for supplying to a power station and has an ash content of 15–20%. The coal may be submitted to a first froth flotation to give a concentrate (a rougher froth) which in turn can be refloated. The refloated concentrate (referred to as a 'cleaner' float) can give a second froth concentrate (a 'cleaner' froth) suitable for use in a steel works. The tailings from the second frother concentrate ('cleaner tailings') can be used in the power station.

This double flotation is shown schematically in the accompanying Figure of the drawings which illustrates an embodiment of the invention.

In this Figure, raw coal is washed and the coarse coal submitted to a power station and steel works. The washed coal fines obtained are submitted to the first flotation, and the first flotation tails are effectively waste. The first froth concentrate obtained is submitted to a second flotation. The second froth concentrate can be used for the steel works whereas the tailings can be submitted to the power station.

In order to illustrate the invention, various experiments were carried out, utilising two different procedures. The procedures for Examples 1 to 5 are set forth below:

PROCEDURE No. I

A coal is first screened on a 0,8 mm sieve to remove the coarse particles. 200 grams are placed in a cell of a DENVER laboratory flotation machine and water added to give a total slurry volume of 2000 ml. The mechanical agitator of the machine is lowered into the slurry and the agitator started and set to run at a speed of ca. 1800 r.p.m. A prescribed amount of collector plus frother is added and agitation continued for exactly 3 minutes (conditioning period). At the end of this period air is forced into the slurry through the agitator blades. The bubbles produced then carry the coal particles to the surface where they are skimmed off and collected in a flat dish. The flotation period is 1 to 3 minutes. The rougher froth collected is slurried with additional water to 4–7% solids and placed in the same DENVER flotation cell. The agitator is placed in the slurry and started, immediately after air is forced into the slurry and th froth produced skimmed off and collected. The s cond flotation is also carried ut for a period of 1–3 minutes. The cleaner froth coll cted and the cleaner tails r maining in the cell are ach filtered, dried, weighed and assayed for ash content.

PROCEDURE No. II

Procedure No. I is followed, except that a small amount of the same coll ctor/frother is added to the cleaner flotation 0,5 minutes prior to th introduction of the air.

Following these procedures, various experiments were carried out with—

(a) a mixture of 90% by weight of sunflower oil and 10% by weight of methyl isobutyl

carbinol (referred to below as M.I.B.C.); and

(b) with 100% by weight of sunflower oil (i.e. with no addition of frother).

The experiments and their results are as follows: Examples I, II and III are flotation experiments with sunflower oil. Examples IV and V are experiments with kerosene plus MIBC (Controls). Comparison of the two series of tests shows that the plant oil gives similar results to that obtained with the petroleum product.

EXAMPLE 1

90% sunflower oil and 10% M.I.B.C.–Procedure No. I was used. 600 grams of fine coal containing 33% ash all passing 0,8 mm in size, were split into 3 equal portions of 200 gram each and floated with 0,06, 0,08 and 0,10 gram of reagent respectively (equivalent to 0,3, 0,4 and 0,5 kg/ton). Results given below show the yields to contain substantially less ash.

Reagent Addition For 1st float For 2nd float	0,06 gram Nil		0,08 gram Nil		0,10 gram Nil	
Yields	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %
Coal in 1st froth–rougher	37,9	11,4	46,5	12,1	58,5	13,4
Coal not floated in cleaner	25,3	13,3	26,7	14,9	27,8	18,8
Coal in 2nd float	12,6	7,6	19,8	8,2	30,7	9,4

EXAMPLE 2

90% sunflower oil and 10% M.I.B.C.–Procedure No. II was used.

600 grams of fine coal containing 33% ash all passing 0,8 mm in size, were split into 3 equal portions of 200 gram each and floated with 0,06, 0,08 and 0,10 gram of reagent respectively. For the second float of the froth, a further 0,02 gram (0,10 kg/ton) of reagent was added. This was done for each test.

Results given below show a greater production of low ash coal in the froth of the 2nd float then obtained in Example 1.

Reagents Addition For 1st float For 2nd float	0,06 gram 0,02 gram		0,08 gram 0,02 gram		0,10 gram 0,02 gram	
Yields	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %
Coal in 1st Float–rougher	41,0	11,9	41,8	11,6	56,3	14,0
Coal not floated in cleaner float	15,4	17,3	12,8	17,2	17,9	21,3
Coal in 2nd froth	25,6	8,7	29,0	9,1	38,4	10,6

EXAMPLE 3

100% sunflower oil–Procedure No. I was followed. 600 grams of fine coal containing 33% ash all passing 0,8 mm in size, were split into 4 equal portions of 200 gram each and floated with 0,10, 0,12, 0,14 and 0,16 respectively (equivalent to 0,5, 0,6, 0,7 and 0,8 kg/ton). The results given below demonstrate that the sunflower oils, besides being a collector, also behaves as an efficient frother. Yield and ash content is similar to that of Example 2 when further reagent

is added to the second flotation.

Reagent Addition For 1st float For 2nd float	0,10 gram Nil		0,12 gram Nil		0,14 gram Nil		0,16 gram Nil	
Yields	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %
Coal in 1st froth–rougher	41,4	12,4	41,3	12,6	45,8	13,2	50,5	13,9
Coal not floated in–cleaner float	17,9	17,1	17,8	17,4	18,7	18,2	18,7	19,6
Coal in 2nd froth	23,5	8,8	23,8	9,0	27,1	9,8	31,8	10,5

EXAMPLE 4

90% Kerosene and 10% M.I.B.C.–Procedure I was followed. 600 gram of fine coal containing 33% ash, all passing 0,8 mm in size, were split into 3 equal portions of 200 gram each and floated with 0,10, 0,12 and 0,14 gram of reagent respectively. Results are as follows:

Reagent Addition For 1st float For 2nd float	0,1 gram Nil		0,12 gram Nil		0,14 gram Nil	
Yields	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %
Coal in 1st froth–rougher	53,8	14,4	66,3	16,2	70,2	16,4
Coal not floated in cleaner	49,3	14,9	52,4	18,2	48,8	19,6
Coal in 2nd float	4,5	8,8	13,9	8,8	21,4	9,1

EXAMPLE 5

90% Kerosene and 10% M.I.B.C.–Procedure II was followed. 600 grams of fine coal containing 33% ash, all passing 0,8 mm in size, were split into 3 equal portions of 200 gram each and floated at 0,10, 0,12 and 0,14 gram of reagent respectively. For the second float of the froth, a further 0,02 gram of reagent was added. Results are given below:

Reagent Addition						
For 1st Float	0,1 gram		0,12 gram		0,14 gram	
For 2nd Float	0,2 gram		0,2 gram		0,2 gram	
Yields	Weight %	Ash %	Weight %	Ash %	Weight %	Ash %
Coal in 1st Froth–rougher	53,0	13,5	67,0	16,0	71,0	16,7
Coal not floated in cleaner	37,0	15,6	41,4	20,1	37,2	22,6
Coal in 2nd float	16,0	8,6	25,6	9,3	33,8	10,3

EXAMPLE 6–PILOT PLANT OPERATION

COMPARISON OF SUNFLOWER SEED OIL AS COAL FLOTATION REAGENT—WITH AND WITHOUT M.I.B.C. COMPARED WITH A KEROSENE—M.I.B.C. MIX (CONTROL)

Coal fines (0,5 mm) from Mine A were slurried in water in a tank to a solids content of 10% by mass.

The coal slurry was pumped at a flow rate of 15 litres per minute to a conditioning tank of 85 litres volume giving a nominal retention time of 6 minutes.

The flotation reagent was pumped continually to the conditioning tank. The slurry then passed to a series of 8 flotation cells each with a volume of 11 litres. The froth was continuously scraped from each cell and collected separately from the tails.

The reagents used were as follows:–

(i) Kerosene with Methyl Isobutyl Carbinol, (M.I.B.C.)–10% mix (as a comparison)

(ii) Sunflower oil with M.I.B.C.–10% mix

(iii) Sunflower oil alone

The reagent flow was adjusted to produce a froth concentrate of 9 to 12% ash.

The results of three tests three roucher flotations were as follows:–

Run No	Reagent	Reagent Addition kg/ton	Froth % Yield	Concentrate % Ash
1	Sunflower Oil	0,32	54,5	9,5
2	+ M.I.B.C.	0,40	56,6	10,5
3		0,48	59,0	11,5
4	Sunflower Oil	0,62	37,0	9,5
5		0,72	47,2	10,5
6		0,86	61,5	11,5
7	Kerosene +	0,39	44,0	9,5
8	M.I.B.C.	0,46	47,0	10,5
9	CONTROL	0,54	52,0	11,5

Results show a better yield using Sunflower Oil plus M.I.B.C than with Kerosene plus M.I.B.C. With a higher addition of sunflower oil alone, the yield is higher than Kerosene plus M.I.B.C. with the same ash content.

CLAIMS

1. A process for the flotation of a mineral, which comprises effecting flotation of the mineral using at least one oil derived from a plant source.
2. A process as claimed in Claim 1, wherein the oil is sunflower oil.
3. A process as claimed in Claim 1 or Claim 2, wherein the mineral is crushed coal.
4. A process as claimed in any of the preceding claims, wherein the mineral is crushed, slurried with water and the plant oil is added, and agitation effected.

5. A process as claimed in Claim 4, wherein a frothing agent is also added.
6. A process as claimed in any of Claims 3 to 5, wherein the flotation provides separate floats of coal having different ash contents.
7. A new process for the flotation of a mineral, substantially as described with reference to any of the examples and/or to the accompanying drawing.

CLAIMS (18 June 1981)
1. A process for the flotation of a mineral, which comprises effecting flotation of the mineral using at least one oil derived from a plant source, the said one oil comprising or consisting of sunflower oil.
2. A process as claimed in Claim 1, wherein the mineral is crushed coal.
3. A process as claimed in Claim 1 or Claim 2, wherein the mineral is crushed, slurried with water and the plant oil is added, and agitation effected.
4. A process as claimed in Claim 3, wherein a frothing agent also is added.
5. A process as claimed in any of Claims 2 to 4, wherein the flotation provides separate floats of coal having different ash contents.
6. A process for the flotation of a mineral, substantially as described with reference to any of the examples and/or to the accompanying drawing.

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